VOLCANIC ASH EFFECTS AND MITIGATION

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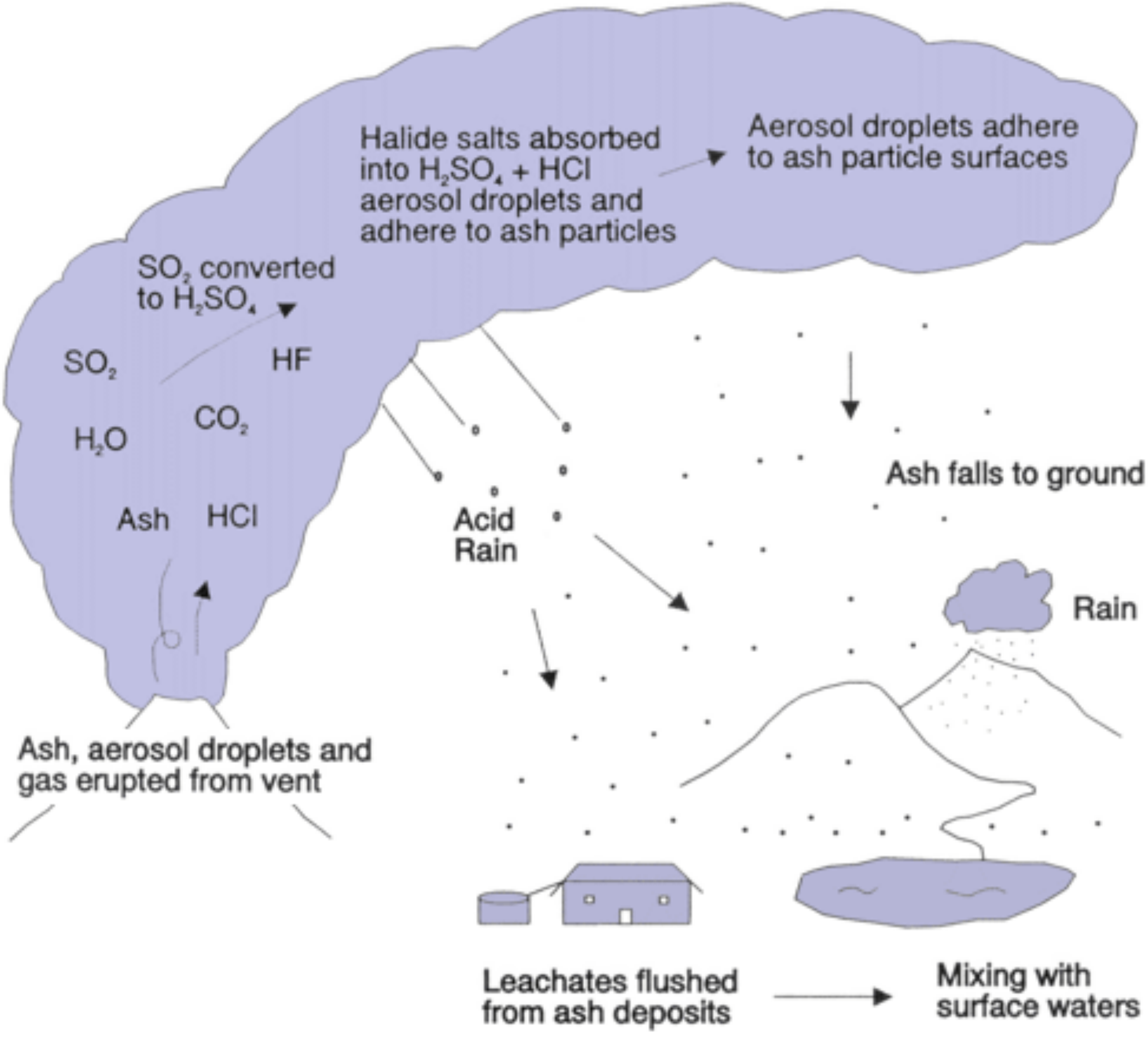
Background

- Research in 1982-83
- 150 + interviews
- 45 Agencies/organizations
    - Airports & air bases
    - Hospitals
    - Universities
    - Semiconductor fabricators
    - IT and communications groups
    - Police & Fire
    - Et. al.
- “What experiences did you ha
from Mt. St. Helens?”

USGS Photo by D.A.Swanson, May 18, 1980

Volcanic Ash Characteristics

- Highly abrasive
- Corrosive
- Conductive (esp. when wet)
- Electrostatically-charged (2-3 days post-eruption)
- Heavy when wet (1400 kg/m^3)
- Easily entrained in air and re-suspended
- Pervasive


Halide salts absorbed into H_2SO_4 + HCl aerosol droplets and adhere to ash particles
Aerosol droplets adhere to ash particle surfaces
SO_2 converted to H_2SO_4
SO_2
HF
CO_2
H_2O
Ash
HCl
Ash, aerosol droplets and gas erupted from vent
Acid Rain
Ash falls to ground
Rain
Leachates flushed from ash deposits
Mixing with surface waters

Volcanic Ash Effects

- Structures – roof loading & collapse
- HVAC
  - Clogging, breakdown of filters
  - Abrasion, electric arcing, overheating
- Cars and light vehicles
  - Abrasion – Motors, brakes, bearings, etc.
  - Melting/condensation in cylinders
  - Electric shorts/arcing – distributors & generators, alternators, starters, etc.
  - Road blockage & traction problems

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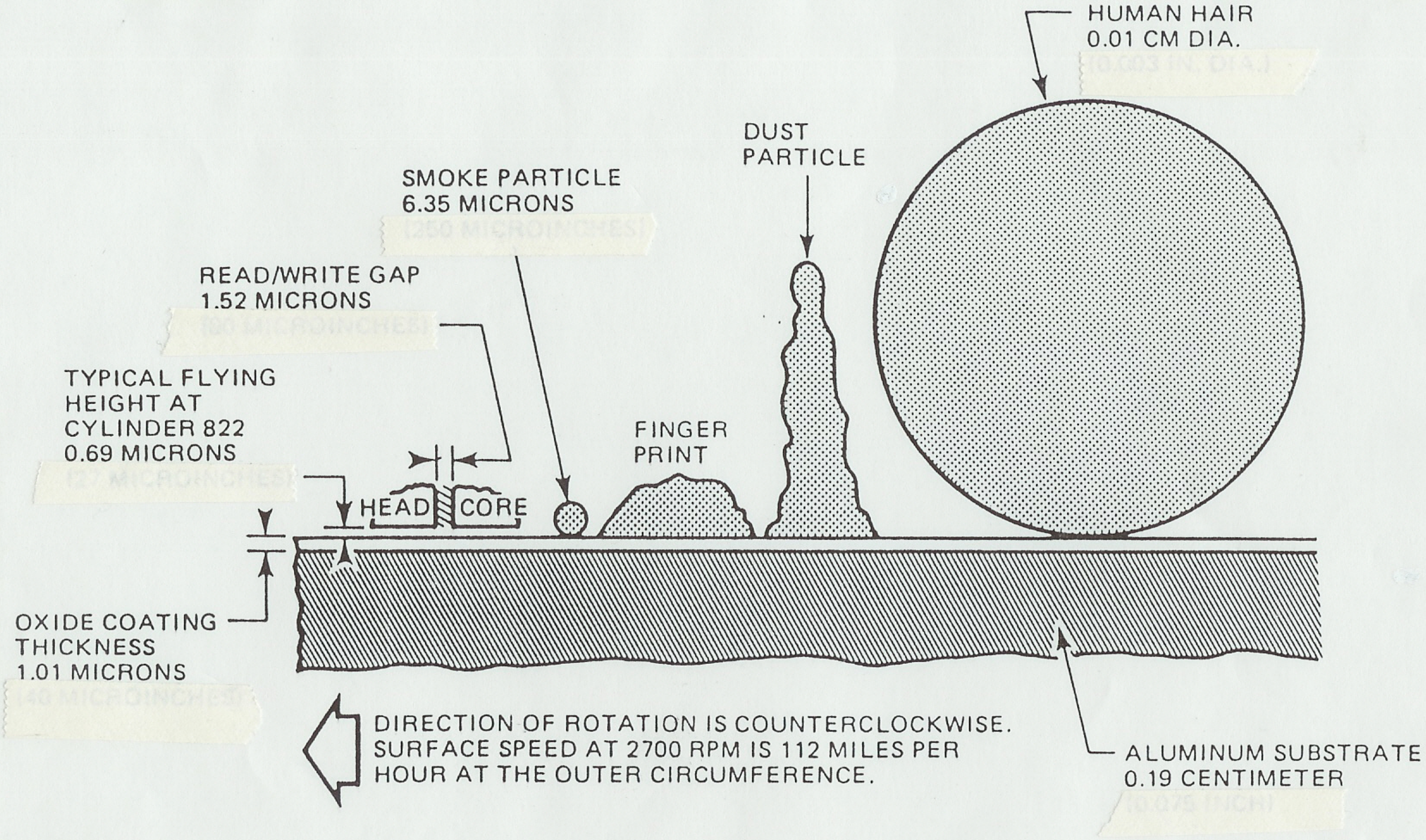
Volcanic Ash Effects (cont.)

- Heavy equipment less affected – designed to operate in dirty environments
- Water & sanitation systems
  - Contamination of open systems
  - Abrasion in pumps, motors
  - Electrical problems
  - Filter clogging – also inlets & C/Bs
  - Siltation, O_2 depletion
  - Impact on cleanup operations?



DIRECTION OF ROTATION IS COUNTERCLOCKWISE. SURFACE SPEED AT 2700 RPM IS 112 MILES PER HOUR AT THE OUTER CIRCUMFERENCE.

Electronic Systems

- Computers
  - Intermittents/upsets
  - Disk drive overheating/damage
  - Printer abrasion and accelerated wear
- Radios & radars
  - Outages (large concentrations of ash)
  - Microwave antenna contamination (filled w/ ash)
  - HV power supply shorts
  - Unusual propagation conditions
- Test equipment and instrumentation
  - Arcing
  - Resistance changes in high-impedance circuits

Electric Power Systems

- Power line transients & outages
  - Arcing/flashover – lines, insulators, transformers
  - Pole fires
- Source loss
  - Generator arcing & bearing abrasion
  - APU failure – ingest large volume of air
  - Accelerated battery drawdown
- Other problems
  - Power cable shorts
  - Floodlights

Volcanic Ash Mitigation

- Basically “low tech”
  - Keep ash out
  - Control what gets in
  - Dispose of and control
- No single technique will suffice
- Balance between continuing operations and mitigating ash effects

Reduce Exposure

- Avoid exposure – evacuate, re-route
- Reduce operations
  - Close facilities
  - Shut down unneeded equipment
- Place vehicles, aircraft, etc. inside

Reduce Severity

- Filtration – install/increase
- Sealing – windows, doors, ports, ducts
- Multi-level protection – “room-in-a-room”
- Positive pressure – vehicles, buildings
- Access controls
- “Clean Room” procedures
- Humidification

Decontaminate

- Wash/flood with water
- Brush/wipe – scratching & scouring
- High-pressure air
- Vacuum

Combination?

- Remove ash without re-entrainment in air?

Reduce Effects

- Accelerate maintenance & cleaning
- Change operating procedures
- Replace contaminated parts – cost-effective?
- Re-design or adapt equipment – add filters, change air flow pattern
- Reduce performance requirements

Dispose & Control

- Wet down, flush surface
- Load when wet – very heavy!
- Vacuum residue
- Dump/cover – emulsified asphalt
- Apply binder on roads
- Plow under
- Stabilize ash –temporary or permanent cover to prevent re-entrainment

Planning for Ash Mitigation

- Vulnerability Assessment
  - Operational systems
  - Support systems
- Priority list of facilities/systems
- Plans & procedures
  - Warning, alert, & notification
  - Reduced/changed operations
  - Protection of critical systems – trade-offs?
  - Accelerated maintenance
  - Cleanup & Disposal
  - Workforce augmentation & training

Planning for Ash Mitigation

- Resources
  - Spare parts
  - Filters
  - Cleaning & Disposal equipment
  - Backup power – for operations and cleaning
  - Water – lots of it!

Volcanic Ash Mitigation

- Pre-planning is vital!
- Mitigation and cleanup may continue for several months
- Multiple eruptions over an extended time
- Elements for success:

Planning

Preparation

Mobilization

Persistence!

For further information:

- http://volcanoes.usgs.gov/
- http://volcanoes.usgs.gov/ash/index.html